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SUBJECT: Impact on OA I/C Systems and I/C Capabilities Caused by Deactivating the CSM During Docked Portions of AAP Missions - Case 620

DATE: June 26, 1969

FROM: A. G. Weygand

ABSTRACT

The impact on the existing instrumentation and communications (I/C) systems of and I/C capabilities of the Orbital Assembly (OA) resulting from deactivation of the entire Command and Service Module (CSM) after docking to the OA during missions of the Apollo Applications Program (AAP) is discussed. It was assumed that the crew could occupy the CSM during the periods of deactivation. Sufficient explanatory detail is contained in the discussions for the reader to determine the impact on the OA I/C systems and I/C capabilities for other conditions such as if the CSM were never to be occupied during the periods of deactivation or if selected portions of the CSM I/C system were to remain active.

The voice communications subsystem of the OA would be the subsystem most affected by deactivation of the CSM I/C system. The audio centers of the CSM form the heart of the OA voice communications subsystem in the current planning. In addition, the only real-time voice communications links between the OA and the Manned Space Flight Network (MSFN) will be provided by the radio frequency subsystems of the CSM.

Since the telemetry subsystem of the CSM would be inactive, acquisition of operational biomedical data from crewmen located in the CSM by the MSFN would not be possible without modification to permit routing of the data from the CSM to the telemetry subsystem of the Airlock Module (AM). Also, since the radio frequency subsystem of the CSM would be inactive, alternate means would be required in the OA to retrieve and transmit to the MSFN data generated by experiments S061 and S071/S072 which will be carried by the CSM according to current planning.



(NASA-CR-106775) IMPACT ON OA I/C SYSTEMS AND I/C CAPABILITIES CAUSED BY DEACTIVATING THE CSM DURING DOCKED PORTIONS OF AAP MISSIONS CASE 620 (Bellcomm, Inc.) 7 p

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MEMORANDUM FOR FILE

A proposal has been made to deactivate all systems of the Command and Service Module (CSM) after it has been docked to the Multiple Docking Adapter (MDA) of the Saturn I Workshop (SIWS - includes the MDA, the Airlock Module and the Orbital Workshop) and the SIWS has been activated during missions of the Apollo Applications Program (AAP). The impact on the existing instrumentation and communications (I/C) systems of and I/C capabilities of the Orbital Assembly (OA - the SIWS plus all modules which are docked to it) resulting from deactivation of the entire I/C system of the CSM is discussed briefly in the following paragraphs of this memorandum. It was assumed for this discussion that deactivation of the CSM does not preclude normal occupancy of the CSM by the crew.

Voice Communications

The subsystem of the OA which will be most affected by deactivation of the CSM I/C system is the voice communications subsystem. In the current design of the OA voice communications subsystem, two multi-wire voice communications hardlines including control lines and numerous umbilical disconnects with control and displays will be routed in parallel throughout the OA but separated and will be connected to different audio centers in the CSM. The two different audio centers will provide the only connection of the transmit and receive portions of the respective multi-wire voice communications hardlines thereby forming two independent duplex conference circuits. The two independent conference circuits may be bridged together to form a single conference circuit by appropriate selection of manual switch positions on the two audio centers. Connection of a conference circuit to a radio frequency (RF) subsystem of the CSM to permit addition of the Manned Space Flight Network (MSFN) to the conference circuit will be accomplished through one of the CSM audio centers at the discretion of the crew. All duplex voice communications between the OA and the MSFN will be provided via an RF link between the CSM and the MSFN (either the Unified S-Band System or the VHF/AM transceivers

or both simultaneously).

Consequently, if the CSM I/C system were deactivated during an AAP mission, the equivalent of two CSM audio centers, exclusive of spares, and a RF system must be added to the SIWS to retain the same voice communications capabilities within the OA and between the OA and the MSFN. The voice communications subsystem hardwire interface between the CSM and the MDA would be somewhat simplified because any audio stations provided in the CSM would consist of umbilical disconnects with controls and displays like those currently provided in the SIWS.

Telemetry

In current planning, data from experiments S061 (Potato Respiration) and S071/S072 (Circadian Rhythm-Pocket Mice/Vinegar Fly) will be modulated, respectively, on two of the scientific subcarriers available in the CSM Unified S-Band (USB) system which will be transmitted to the MSFN by the S-Band FM transmitter of the CSM USB system. In addition, operational biomedical data (electrocardiogram, heart rate, impedance pneumograph, and body temperature) collected from each crewman when located in the CSM will be routed to the CSM pulse code modulation (PCM) telemetry subsystem where the data will be digitized and time-multiplexed with CSM systems performance and status data to form a single PCM signal. This PCM signal will be transmitted to the MSFN via the CSM USB system. It should be noted that operational biomedical data collected from crewmen in other parts of the OA or performing extravehicular activity (EVA) will be digitized and included in the real-time PCM signal generated by the PCM telemetry subsystem of the Airlock Module (AM).

Consequently, if the CSM I/C system were deactivated during an AAP mission, alternate means must be provided in the OA to retrieve and transmit to the MSFN data generated by experiments S061 and S071/S072 and the hardwire interface between the CSM and the MDA must be expanded to permit routing of operational biomedical data collected from crewmen in the CSM to the PCM telemetry subsystem of the AM. It should also be noted that no data on CSM systems status (pressures, temperatures, gas concentrations, etc.) such as on the crew environment, the propulsion systems, and other systems which would be of interest even if the CSM were deactivated would be available to the crew in the CSM or to the MSFN because the instrumentation sensors as well as displays and telemetry subsystem would be inactive.

Up-Data

If the CSM I/C system were deactivated, the crew in the OA could not be alerted via the up-data portion of the CSM USB system as is currently planned. However, a crew alert capability will still exist via the up-data subsystem of the AM which will also be provided according to current planning. Furthermore, neither real-time on/off commands nor Command Module Computer (CMC) and Central Timing Equipment (CTE) up-dates would be possible even if desired which is not likely.

Since the USB system of the CSM would be inactive, the requirement to provide the capability to select for use one of the four S-Band omni-directional antenna elements of the CSM via the up-data subsystem of the AM could be deleted. The deletion of this requirement would simplify the hardware interface between the CSM and the MDA.

Tracking

The S-Band transponder of the CSM USB system will provide the only active assistance to the MSFN for tracking of the OA to permit periodic up-dating of the OA ephemeris. If the CSM USB system were inactive, tracking data could be provided by various stations of the MSFN by skin tracking the OA using C-Band pulse radars although the accuracy of this tracking data would be inferior to the data which could be obtained using the USB system.

Television

The only existing capability for the transmission of real-time commercial quality television from the OA to the MSFN would be sacrificed if the S-Band FM transmitter of the USB system of the CSM were deactivated.

Caution and Warning

If the CSM I/C system is deactivated, the caution and warning subsystem (CWS) of the CSM will not be operating. Since crewmen may be occupying the CSM, power must be supplied across the CSM/MDA interface to support that portion of the CSM CWS which provides an appropriate alarm and display when an emergency, warning, or caution condition exists in another module of the OA. If the requirement that the caution and warning tones shall not cross the interface between two vehicles of the OA is eliminated for this case, caution and warning

tones could be provided to crewmen in the CSM from the AM CWS via the voice communications hardlines in the same manner that caution and warning tones are provided by the AM CWS to the crewmen located anywhere in the S1WS. In this case, no CWS display would be provided in the CSM. Adopting this solution to provide the crewmen in the CSM with an indication of the existence of an unsafe condition from other vehicles in the OA will have a slight impact on the hardwire interface between the CSM and MDA to provide a transmission path for the alarm tones.

Power

Power must be supplied across the CSM/MDA hardline interface to support the biomedical instrumentation harnesses of the crewmen when located in the CSM, the audio station control and display panel(s) in the CSM, and the microphones and headsets of the crewmen when located in the CSM if the CSM were deactivated.

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